

Keystone Biology Review Guide – Evolution

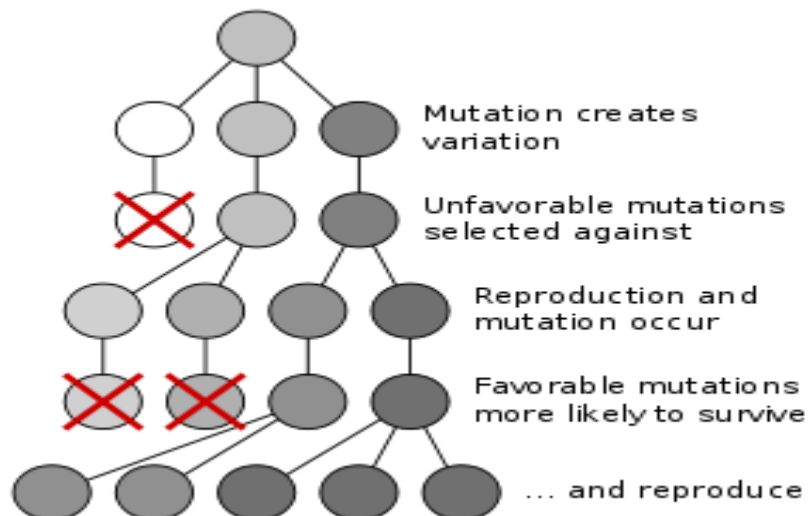
- **BIO.B.3.3 Apply scientific thinking, processes, tools, and technologies in the study of the theory of evolution.**
- **BIO.B.3.3.1 Distinguish between the scientific terms: hypothesis, inference, law, theory, principle, fact, and observation.**

Observation	The process of obtaining information by using the senses; the information obtained by using the senses
Hypothesis	A proposed, scientifically testable explanation for an observed phenomenon.
Theory (Scientific)	An explanation of observable phenomena based on available empirical data and guided by a system of logic that includes scientific laws; provides a system of assumptions, accepted principles, and rules of procedure devised to analyze, predict, or otherwise explain the nature or behavior of a specific set of phenomena.
Law (Scientific)	A law that generalizes a body of observations. At the time it is made, no exceptions have been found to a law. It explains things but does not describe them; serves as the basis of scientific principles.
Fact	Any observation that has been repeatedly confirmed and accepted as true; any scientific observation that has not been refuted
Inference	A conclusion or opinion that is formed from known facts, evidence, or observations
Principle (Scientific)	A concept based on scientific laws and axioms (rules assumed to be present, true, and valid) where general agreement is present.

Pre-1950s – evidence for evolution and the theory of natural selection has been gathered by investigations rather than experimentation.

Today – The theory of natural selection continues to be formed, challenged and revised through investigations and our new understandings of genetics.

- **BIO.B.3.1 Explain the mechanisms of evolution.**
 - **Natural Selection**
 - Organisms in a population adapt to their environment as the proportion of individuals with genes for favorable traits increases.
 - Those individuals that pass on more genes are considered to have greater **fitness**.



- **BIO.B.3.1.1 Explain how natural selection can impact allele frequencies of a population.**

- **Allele-** A variation of a gene's nucleotide sequence (an alternative form of a gene).
 - Examples: gene A, gene a
- **Allelic Frequency-** The measure of the relative frequency of an allele in a population; expressed as a proportion or percentage.
 - Examples: AA = 25% Aa=50% aa=25%
- ****Natural selection** does not necessarily favor a “dominant” trait. It usually favors the most beneficial trait. This trait may be dominant or recessive.
- Alleles for traits may be beneficial, harmful or neutral

- **BIO.B.3.1.2 Describe the factors that can contribute to the development of new species (e.g., isolating mechanisms, genetic drift, founder effect, migration).**

Gene Flow – movement of genes from one population to another (by migration or dispersal of seeds/spores)

Genetic Drift – allele frequencies in a population change as a result of random events or chance. Examples: small populations hit by a natural disaster or a disease; failure to reproduce

Migration may affect a population by bringing in new genes/traits to an area or taking genes/traits out of an area.

Founder effect is the loss of genetic variation that occurs when a new population is established by a very small number of individuals from a larger population. Example: A flood kills all but a few squirrels in an area. The resulting population will have the same traits as those few. This may be good or bad for the group!

Speciation – the process of forming new species. Existing species are basically changed versions of older species (many now extinct). How does this happen? Usually due to types of **isolating mechanisms**:

1. **Geographic Isolation-** physical separation of a habitat divides a population into two (prevents individuals from meeting mating with each other).
 - a. Examples: Grand Canyon, a mountain range, a river
2. **Habitat Isolation** - high up in a tree is a long way from the ground though both share geographical ranges; an individual that sticks to the canopy will only rarely contact an individual who sticks to the ground
3. **Mechanical Isolation** – the “parts” don’t fit - flowering plants that may be adapted to pollination by one insects but not another.
4. **Behavioral Isolation** - Mating calls change in frogs – do not recognize...therefore don’t mate.
5. **Gametic Isolation** - an incompatibility between sperm and egg, usually due to physical changes between subpopulations
6. **Temporal Isolation** - Two individuals who breed only at certain times and not at overlapping times (ex. Day vs Night)
7. **Reproductive Isolation** – does *not* mean that individuals within two populations are *not* mating nor producing offspring within populations; instead, if there are offspring, those offspring are not contributing their alleles to either of the parental populations (e.g., because these hybrid offspring are sterile and/or do not survive to reproduce)
 - a. Translated: Offspring do not develop completely to be able to reproduce or they die earlyno new offspring. Ex. Horse + Donkey = Mule

TYPES of EVOLUTION

- **Convergent Evolution** is the process by which different species evolve similar traits
 - Example: the evolution of sharks and dolphins
 - **Divergent Evolution** is a process in which the descendents of a single ancestor diversify into species that each fit different parts of the environment.
 - Example: Darwin's Finches
 - Sometimes, a new population in a new environment will undergo divergent evolution until the population fills many parts of the environment. This pattern of divergence is called adaptive radiation
 - Example: Caribbean anole lizards
 - **Artificial Selection** is a process when a human breeder chooses individuals that will parent the next generation
 - Example: Breeding Dogs
 - **Coevolution** is when two or more species have evolved adaptations to each other's influence
 - Evolution is ongoing and many species can be evolving at once
 - Each species is part of the forces of natural selection that act upon the other species
 - Example: humans have developed and used antibiotics, but many bacteria have evolved adaptations to resist the effects of some antibiotics!
- **BIO.B.3.1.3 Explain how genetic mutations may result in genotypic and phenotypic variations within a population.**
 - **POPULATION GENETICS** IS THE STUDY OF EVOLUTION FROM A GENETIC POINT OF VIEW.
 - **MICROEVOLUTION** IS A CHANGE IN THE COLLECTIVE GENETIC MATERIAL OF A POPULATION.
 - POPULATION GENETICISTS USE THE TERM **GENE POOL** TO DESCRIBE THE TOTAL GENETIC INFORMATION AVAILABLE IN A POPULATION.
- Mutation** – a random change in a gene that is passed to offspring. May be beneficial, harmful or neutral.
1. If the gene is passed on, there is now more variation for a trait in the population.
 2. If the gene is dominant, it will be expressed phenotypically. (Examples DD or Dd)
 3. If the gene is recessive, it will be hidden unless the individual mates with another recessive. (dd)

- **BIO.B.3.2.1 Interpret evidence supporting the theory of evolution (i.e., fossil, anatomical, physiological, embryological, biochemical, and universal genetic code).**
 - **Fossil s** – scientists compare age of fossils by their position in the layers of the earth. The deeper the fossil is the older it is. (relative age).
 - **Biogeography** – the study of locations of organisms around the world. Ex. Marsupials in Australia probably evolved in isolation.
 - **Biochemical** – Biologists compare the DNA, RNA and proteins between organisms.
 - The more similarities the more closely related through a common ancestor.
 - The greater the number of different base pairs, the more distant the evolutionary relationship.
 - All living things share the same 20 amino acids, differing in arrangements & numbers
 - **Universal Genetic Code** – all living things share the same 4 nucleotides – A, T, C, G
 - **Anatomy** – the study of body structure
 - **Homologous Structures** – similar in *structure* but may differ in *function* (human arm, bat wing, penguin flipper)...organisms are more closely related
 - **Analogous Structures** – similar in *function* but differ in *structure* (birds, bats, moths)...organisms are less closely related
 - **Vestigial Structures** – seem to serve no function in one animal, but resemble structures with functions in other animals (a pelvis in a whale?! Human appendix, Wisdom teeth)
 - **Embryology** – the study of how organisms develop (stages of early embryo/fetal development is very similar in some vertebrates – suggesting a common ancestor)